

## CLAIMS

1. A tunable microwave arrangement (10;20;30;40;50) comprising  
5 a microwave/integrated circuit device (11;12;13;14;15) and a  
substrate (6),  
c h a r a c t e r i z e d i n  
that it comprises a layered structure disposed between said  
microwave/integrated circuit device and said substrate  
10 (5;5';5'';5''' ;5<sup>4</sup>;5<sup>5</sup>), that said layered structure acts as a  
ground plane and comprises at least one regularly or irregularly  
patterned first metal layer (1;1';1'';1''' ;1<sup>4</sup>;1<sup>5</sup>;1<sup>6</sup>), at least one  
second metal layer (3;3<sup>4</sup>;3<sup>5</sup>), at least one tunable ferroelectric  
film layer (2;2<sup>4</sup>;2<sup>5</sup>;2<sup>6</sup>), whereby said layers are so arranged that  
15 the ferroelectric film layer(s) (2;2<sup>4</sup>;2<sup>5</sup>;2<sup>6</sup>) is/are provided  
between the/a first metal layer (1;1';1'';1''' ;1<sup>4</sup>;1<sup>5</sup>;1<sup>6</sup>) and the/a  
second metal layer (3;3<sup>4</sup>;3<sup>5</sup>).
2. A tunable microwave arrangement according to claim 1,  
20 c h a r a c t e r i z e d i n  
that the patterned first metal layer(s) (1;1';1'';1''' ;1<sup>4</sup>;1<sup>5</sup>;1<sup>6</sup>)  
comprise(s) (a) patterned Electromagnetic Bandgap crystal  
structure.
- 25 3. A tunable microwave arrangement according to claim 1 or 2,  
c h a r a c t e r i z e d i n  
that the ferroelectric film layer(s) (2<sup>4</sup>) is/are patterned.
4. A tunable microwave arrangement according to claim 1 or 2,  
30 c h a r a c t e r i z e d i n  
that the ferroelectric film layer(s) is/are homogeneous (2), i.e  
not patterned.

5. A tunable microwave arrangement according to any one of claims 1-4,

characterized in

that the second metal layer(s) (3) is /are homogeneous, i.e not  
5 patterned.

6. A tunable microwave arrangement according to any one of claims 1-4,

characterized in

10 that the second metal layer(s) (3<sup>4</sup>) is/are patterned.

7. A tunable microwave arrangement according to any one of the preceding claims,

characterized in

15 that the second metal layer(s) (3; 3<sup>4</sup>; 3<sup>5</sup>) comprise(s) Pt, Cu, Ag, Au or any other appropriate metal.

8. A tunable microwave arrangement according to any one of the preceding claims,

20 characterized in

that the ferroelectric film layer (2; 2<sup>4</sup>; 2<sup>5</sup>; 2<sup>6</sup>) comprises SrTiO<sub>3</sub>, Ba<sub>x</sub> Sr<sub>1-x</sub> TiO<sub>3</sub> or a material with similar properties.

9. An arrangement according to any one of the preceding claims,

25 characterized in

that the ground plane structure is tunable, and in that for tuning a DC voltage is applied between the/a first metal layer (1) and the/a second metal layer (3).

30 10. An arrangement according to claim 9,

characterized in

that tuning of the microwave/integrated circuit device is achieved through the tuning of the ground plane, particularly without requiring any decoupling circuits on the device.

- 5 11. An arrangement according to claim 9 or 10,  
c h a r a c t e r i z e d i n  
that through the application of the DC biasing (tuning) voltage,  
the dielectric constant of the first metal layer (1) is affected,  
changing the impedance of the ground plane surface adjacent the  
10 microwave/integrated circuit device.
12. An arrangement according to any one of the preceding claims,  
c h a r a c t e r i z e d i n  
that the microwave circuit comprises a microstrip line or coupled  
15 microstrip lines (13,13;15,15,15).
13. An arrangement according to any one of claims 1-11,  
c h a r a c t e r i z e d i n  
that the microwave circuit comprises a patch resonator (11;12;16):  
20
14. An arrangement according to any one of claims 1-11,  
c h a r a c t e r i z e d i n  
that the microwave circuit comprises an inductor coil (14).
- 25 15. An arrangement according to any one of claims 1-11,  
c h a r a c t e r i z e d i n  
that the micorwave device comprises a microwave transmission line.
16. An arrangement according to any one of claims 1-11,  
30 c h a r a c t e r i z e d i n  
that the microwave device comprises a coplanar strip line device.

17. An arrangement according to any one of the preceding claims,  
c h a r a c t e r i z e d i n  
that the substrate(s) comprises a semiconductor, e.g Si, a  
dielectricum, a metal or a material with similar properties.

5

18. An arrangement according to any one of the preceding claims,  
c h a r a c t e r i z e d i n  
that between the microwave device and the (top) patterned first  
metal layer (1) a low permittivity, low loss dielectricum (4) is  
provided.

10

19. An arrangement according to claim 18,  
c h a r a c t e r i z e d i n  
that the dielectricum (4) comprises a BCB or any other polymer.

15

20. An arrangement according to any one of the preceding claims,  
c h a r a c t e r i z e d i n  
that the applied tuning voltage is lower than 100 V.

20

21. An arrangement according to claim 20,  
c h a r a c t e r i z e d i n  
that the tuning voltage is lower than about 10 V.

25

22. An arrangement according to any one of the preceding claims,  
c h a r a c t e r i z e d i n  
that the ferroelectric layer (2) has a thickness of about 1-2  $\mu\text{m}$ .

30

23. An arrangement according to any one of claims 1-11,  
c h a r a c t e r i z e d i n  
that the integrated circuit device comprises a semiconductor  
integrated circuit.

24. An arrangement according to any one of the preceding claims,  
c h a r a c t e r i z e d i n  
that the ground plane structure comprises a multilayer structure  
with more than one ferroelectric layer ( $2^5, 2^6$ ), each ferroelectric  
5 layer being disposed between a first and a second/a (first) metal  
layer ( $1^5, 1^6, 1^6, 3^5$ ).

25. A method for tuning a microwave arrangement comprising a  
microwave/integrated circuit device and a substrate,

10 c h a r a c t e r i z e d i n  
that the microwave arrangement further comprises a layered  
structure acting as a ground plane for the arrangement and being  
disposed between the microwave/integrated circuit device and the  
subtrate, the method comprising the step of:

15 - applying a DC tuning voltage between a first patterned metal  
layer (1) and a second metal layer (3) disposed on opposite  
sides of a ferroelectric layer (2), which layers (1, 2, 3)  
constitute the ground plane of the arrangement.

20 26. A method according to claim 25,  
c h a r a c t e r i z e d i n  
that the patterned first metal layer(s) comprise(s) a patterned  
Electromagnetic Bandgap crystal structure.

25 27. A method according to claim 25 or 26,  
c h a r a c t e r i z e d i n  
that for tuning the microwave/integrated circuit device, the step  
of applying a DC voltage influences the impedance on top of the  
ground plane, thus changing the resonant frequency of the  
30 microwave/integrated circuit device.

28. A method according to any one of claims 25-27,  
c h a r a c t e r i z e d i n

16

that it comprises the step of, in a multilayered ground plane structure comprising more than two ferroelectric film layers:

- selecting any of the first and second metal layers surrounding any of the ferroelectric films for tuning the microwave/integrated circuit device.

10

15

20

25

30